Utilization of Pond Fly Ash as a Partial Replacement in Fine Aggregate with Using Fine Fly Ash and Alccofine in HSC-Hards Concrete Properties

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Abstract — **India is developing country and it depends upon the thermal power plants for power requirements.75% power generation of India by thermal generation plants and 90 % of it is coal-based generation. Use of coal bring huge amount of ash every year. It was generated around 170 million ton in 2010. Almost generated ash handled in wet form and disposed of in ash ponds.[1] Generated ash ponds are very harmful to environment. Using this fly ash as a replacement of fine aggregates. The main aim of this study is to get the economical and eco-friendly High Strength Concrete (HSC). The hard concrete test carried out for finding properties of this concrete at harden stage.**

***Index Terms*—Alccofine, Fly ash pond, High Strength Concrete, Replacement of cement.**

I. INTRODUCTION

A fly ash pond is an engineered structure for the disposal of bottom ash and fly ash. The wet method consists of constructing a large "pond" and filling it with fly ash slurry, allowing the water to drain and evaporate from fly ash over time[2].

A pozzolan is siliceous or siliceous and aluminous material which, in itself, possesses little or no cementitious value but which will, in finely divided form and in the presence of water, react chemically with calcium hydroxide at ordinary temperature to form compounds possessing cementitious properties (ASTM C618).[3]

Fig -1 Fly ash pond
(Image Courtesy :Shaila Dewan; Published 6th January, 2009)

Concrete is mostly used artificial material all over the world and has played main role in development of all countries. For higher and higher requirements in last past few years many research has been done on concrete t make it more durable and higher strength. In 1970's compressive strength more than 40 N/mm2 known as high- strength concrete. Later 60-100 N/mm2 compressive strength classified as High-strength concrete.

As per M60 Mix design in this research the Alccofine and fine fly ash partially replaced with cement and pond fly ash as a replacement of fine aggregates. In mix G1, G2 and G3 cement replaced by Alccofine 4% and fine fly ash 26% and pond fly ash varies 10%, 20%, 30% as replacement of fine aggregates. Similarly in mix G4, G5 and G6 fine fly ash 24% and pond Fly ash same as 10%, 20% and 30%

II. MATERIALS

Pond fly ash in concrete has been replaced by fine aggregates. Its properties shown in table-1

Table -1 Chemical Composition of Pond Fly Ash

Ingredients	Percentage	Ingredients	Percentage
Cao	0.25	Total Chloride	0.002
Sio_2	73.6	Loss on Ignition	3.7
Al_2O_3	9.1	Fe_2O_3	1.35
MgO	0.05	TiO_2	Nil
SO_3	0.01	P_2O_3	0.0001
NaO_2	0.004	K_2O	0.002

Table – 2 Mix Proportion

M60	**G1**	**G2**	**G3**
CEMENT(kg)	420	420	420
FLY ASH(kg)	156	156	156
ALCCOFINE(kg)	24	24	24
WATER(kg)	198	210	221
F.A.(kg)	676.8	601.6	526.4
P.A.(kg)	75.2	150.4	225.6
C.A.(20 mm)(kg)	672	672	672
C.A.(10 mm)(kg)	448	448	448
ADMIXER(kg)	5.3	5.3	5.3
W/B	0.33	0.35	0.37

M60	**G4**	**G5**	**G6**
CEMENT(kg)	420	420	420
FLY ASH(kg)	144	156	144
ALCCOFINE(kg)	36	36	36
WATER(kg)	198	210	221
F.A.(kg)	676.8	601.6	526.4
P.A.(kg)	75.2	150.4	225.6
C.A.(20 mm)(kg)	672	672	672
C.A.(10 mm)(kg)	448	448	448
ADMIXER(kg)	5.3	5.3	5.3
W/B	0.33	0.35	0.37

III. EXPERIMENTAL PROGRAM

A. Compressive strength study

Concrete samples were made by using ordinary Portland cement. The composition of the mortar mix is shown in table -2. Moulds with dimensions of 150 mm× 150 mm× 150 mm. After casting, all moulds were placed in a normal temperature of room with a relative humidity of more than 90% for a period of 24h. After de-moulding, the specimens were placed for the curing At the time of testing, cubes were took out from the water, excess water was wiped out by jute cloth and placed it on the platform of compression testing machine. 7^{th}, 28^{th} and 56^{th} days compressive strength was measured. Compressive strength results are shown in table -3.

Fig 1 Compression test

B. Flexural strength study

Concrete Beams grade M60 were made by using ordinary Portland cement. Moulds with dimensions of 750 mm× 150 mm× 150 mm. After casting, all moulds were placed in a normal temperature of room with a relative humidity of more than 90% for a period of 24h. After de-moulding, the specimens were placed for the curing till testing day. Test results of flexural strength given in table no – 4.

IV. TEST RESULTS

Table 3 Compressive strength test results

Mix Proportion	**Avg. Comp. Strength**	**Avg. Comp. Strength**	**Avg. Comp. Strength**

	(N/mm^2) At 7^{th} day	(N/mm^2) At 28^{th} day	(N/mm^2) At 56^{th} day
G1	39.5	46.8	60.77
G2	36.5	42.0	61.17
G3	32.0	40.2	51.05
G4	50.4	62.0	70.96
G5	46.3	55.9	65.43
G6	42.1	59.4	68.18

Table 4 Flexural Strength Test results

Sr. No.	Mix Proportion	Flexural Strength (N/mm^2)
1	G1	5.54
2	G2	4.8
3	G3	5.07
4	G4	4.84
5	G5	4.62
6	G6	4.8

Table 4 Split Tensile Test results

Sr. No.	Mix Proportion	Tensile strength at 28^{th} day (N/mm^2)	Tensile strength at 28^{th} day (N/mm^2)
1	G1	3.57	4.79
2	G2	3.77	4.13
3	G3	2.89	4.71
4	G4	3.98	4.70
5	G5	3.46	4.24
6	G6	4.49	5.13

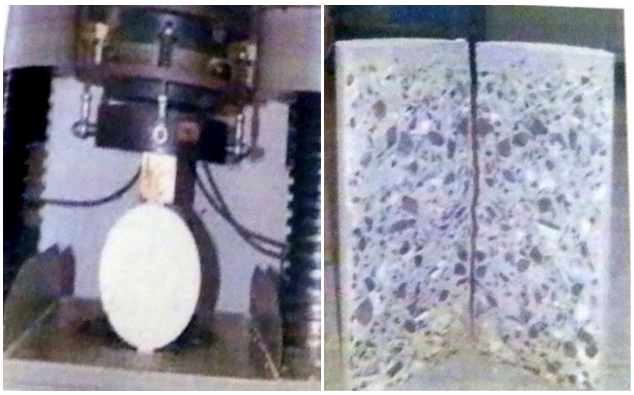

Fig 3 Split tensile Test

C. Split Tensile strength study

Split tensile test carried out as shown in figure -3. The specimen was placed in machine in such manner that the load should be concentrate at one-third point only. The result of split tensile test is given in table no -5.

V. Discussion

A. Compressive strength

Compressive strength of concrete mixes made with pond ash was determined at 7^{th}, 28^{th} and 56^{th} days. The pond ash concrete gains strength at slower rate in the initial period and acquires strength at faster rate beyond 28 days, due to pozzolonic action of pond ash

B. Flexural Strength

From the test results shows the flexural strength development with age and shows variation of flexural strength for various percentages of pond Ash. The flexural strength is affected to more extent with the increase in pond ash concrete. It is believed to be due to poor interlocking between the aggregates, as pond ash particles are spherical in nature.

C. Split Tensile Strength

It is observed from results that the splitting tensile strength of concrete decreases with the increase in the percentage of fine aggregates replacement with the pond ash, but splitting tensile strength increases with the age of curing. The splitting tensile strength gain more at 30% replacement of fine aggregates with pond ash in G6 proportion.

VI. CONCLUSIONS

A. Compressive strength

Compressive strength getting highest strength at using 6% Alccofine as a cement replacement and 10% pond ash a replacement in fine aggregates. highest compressive strength getting 70.76 N/mm^2 at 56th day.

B. Flexural Strength

Maximum Flexural Strength 4.84 N/mm2 getting at using 6% Alccofine and 10% pond ash usage at 28th day.

C. Split Tensile Strength

The maximum split tensile strength of cylinder getting maximum at using 6% Alccofine and 10% pond fly ash at 56th day.

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